Global Journal of Fisheries Science
Volume 7(5), pages 153-166, December 2025
Article Number: 090BC0184
ISSN: 2782-750X
https://doi.org/10.31248/GJFS2025.097
https://integrityresjournals.org/journal/GJFS

Review Article

Assessing sustainable fishing strategies in Nigeria's artisanal fisheries

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Received 1st December 2025; Accepted 26th December 2025

ABSTRACT: Artisanal fisheries are vital to Nigeria's food security, livelihoods, and socio-economic stability, supplying over 80% of domestic fish and employing millions across coastal and inland communities. Despite their importance, the sector faces significant challenges, including overfishing, weak governance, climate change, pollution, and limited adherence to sustainable practices. This study provides a qualitative assessment of sustainable fishing in Nigeria's artisanal fisheries through a systematic review of literature, policy documents, and institutional reports published between 2010 and 2025. Findings reveal widespread unsustainable practices driven by poverty, poor regulatory enforcement, and limited fisher education. Nevertheless, traditional ecological knowledge, community-based governance, and emerging strategies, such as selective gear use, seasonal closures, and aquaculture, show potential for sustainability. The study emphasizes the role of local institutions, inclusive stakeholder participation, and integration of indigenous knowledge in enhancing ecological stewardship and climate resilience. Policy recommendations include strengthening co-management frameworks, improving monitoring, and promoting socio-economic incentives for sustainable practices. Achieving sustainability requires a multidimensional approach that balances ecological integrity with socio-economic realities, empowering communities and fostering collaborative governance.

Keywords: Artisanal fisheries, climate change, ecosystem-based management, food security, small-scale fisheries, sustainability.

INTRODUCTION

Artisanal fisheries in Nigeria constitute a vital part of the country's socio-economic landscape, significantly contributing to local economies and food security. These fisheries rely on small-scale operations that employ traditional fishing methods, limited technology, and a wide array of species. According to Zeller *et al*. (2023), small-scale fisheries act as informal social protection systems, especially in remote areas with limited employment alternatives, thereby playing a key role in poverty alleviation and food security. This is particularly important in Nigeria, where over 60% of domestic fish production originates from artisanal fishers, supporting both nutritional needs and livelihoods (Bamigboye and Koledoye, 2022; Akintola *et al.*, 2025a).

Understanding fisherfolk perceptions is essential for improving fishing efficiency and outcomes, which in turn strengthens local economies (Ifabiyi and Adisa, 2022; Hridoy *et al*., 2025a). Compared to industrial fishing, artisanal fisheries often provide greater social and environmental benefits, including job creation and reduced ecological impact (López-Angarita *et al*., 2018; Belhabib *et al*., 2017). Prosperi *et al*. (2019) similarly emphasize the adaptability and resilience of small-scale fisheries to fluctuating market conditions, a feature that supports their long-term sustainability and the well-being of coastal communities.

However, artisanal fisheries face escalating threats, including overfishing and weak governance, necessitating urgent measures to promote sustainable practices that balance ecological health with economic viability (Sogbesan and Kwaji, 2018; Akintola *et al.*, 2025a). The Food and Agriculture Organisation (FAO) reports that 31.4% of global commercial fish stocks are overexploited, underscoring the need for effective management strategies (Liem *et al*., 2018). Traditional fisheries management, which often emphasizes maximizing yields, has been criticised for overlooking the ecological processes essential for maintaining healthy fish populations (Kolding and Zwieten, 2014). In contrast, ecosystem-based fisheries management (EBFM) integrates ecological and socio-economic considerations, fostering sustainable harvests while preserving the overall integrity of marine ecosystems (Trochta *et al*., 2018; Bordin *et al*., 2025).

Research confirms that fisheries governed by strong sustainability frameworks tend to achieve more stable yields and better ecosystem outcomes (Halpern *et al.*, 2015; Bundy *et al*., 2016). Such strategies are particularly relevant for Nigeria, where sustainable artisanal practices can enhance both ecological resilience and socio-economic stability. Bundy *et al*. (2016) note that effective governance and adherence to sustainability standards contribute significantly to stock recovery and improved ecosystem health.

Given the critical role of artisanal fisheries, a focused assessment of their sustainability is both timely and necessary. This review explores current practices, identifies key challenges, and proposes actionable recommendations to ensure the long-term viability of Nigeria's artisanal fisheries.

MATERIALS AND METHODS

This study adopts a qualitative review approach to assess the current state of sustainable fishing practices in Nigeria's artisanal fisheries sector. The methodology is grounded in a systematic literature review, drawing from peer-reviewed academic publications, policy documents, reports from international organisations, and institutional data relevant to fisheries governance, environmental sustainability, and socio-economic development in Nigeria.

Literature search strategy

A comprehensive literature search was conducted using academic databases including **ScienceDirect, Scopus, Google Scholar**, and **PubMed**, as well as institutional repositories from organisations such as the **Food and Agriculture Organisation (FAO), WorldFish**, and Nigeria's **Federal Department of Fisheries (FDF)**. Keywords used in the search included: *"artisanal fisheries Nigeria"*, *"sustainable fishing practices"*, *"ecosystem-based management"*, *"climate change and fisheries"*, *"co-management in fisheries"*, *"illegal, unreported and unregulated (IUU) fishing"*, and *"fisherfolk livelihoods"*. The search was limited to materials published between **2010 and 2025**, to ensure relevance and inclusion of recent data, with preference given to peer-reviewed journals, technical reports, and verified policy papers.

Inclusion and exclusion criteria

Documents were included if they met the following criteria:

- Focused on artisanal or small-scale fisheries in Nigeria or similar West African contexts;
- Addressed issues related to sustainability, environmental impact, governance, socio-economic dynamics, or traditional knowledge in fisheries;
- Published in English;
- Peer-reviewed, or published by reputable institutions (e.g., FAO, UNEP, NIMASA, etc.).

Exclusion criteria involved:

- Studies focused exclusively on industrial or commercial fisheries;
- Articles lacking empirical or conceptual grounding in sustainability frameworks;
- Non-English sources and grey literature with unverifiable data.

Data extraction and thematic analysis

Relevant literature was screened, coded, and synthesised through **thematic content analysis**. The data were organised into major themes aligned with the research objectives:

- Traditional fishing practices and their ecological implications;
- Socio-economic drivers and barriers to sustainability;
- Governance structures and regulatory frameworks;
- Climate and environmental impacts on artisanal fisheries;
- Sustainable fishing interventions, including case studies of successful practices.

The findings were then critically analysed to identify gaps, challenges, and best practices, with recommendations developed based on empirical evidence and policy relevance.

CURRENT STATE OF ARTISANAL FISHERIES IN NIGERIA

The state of artisanal fisheries in Nigeria is shaped by environmental, economic, and governance challenges.

Among the most pressing concerns is the impact of climate change. Alterations in rainfall patterns, temperatures, and wind conditions have disrupted fishing activities, leading to declining fish stocks and worsening livelihoods for fishers (Okeke-Ogbuafor *et al.*, 2022). Vulnerability varies by region, with some communities more severely affected than others. This situation is aggravated by illegal, unreported, and unregulated (IUU) fishing, which further undermines the sustainability of fish stocks (Okeke-Ogbuafor *et al*., 2022; Belhabib *et al*., 2017).

Economically, artisanal fisheries remain central to Nigeria's food system, accounting for over 85% of domestic fish production and contributing approximately 5% to the national GDP (Sogbesan and Kwaji, 2018; Akintola *et al*., 2025a). Fish is a major protein source for many Nigerians, with per capita consumption at 14.9 kg (Adisa *et al*., 2021). Yet, the growing demand for fish products exceeds local production, prompting reliance on imports (Obot, 2020; Olaoye and Ojebiyi, 2018). This production-consumption gap underscores the need for improved management and capacity-building among artisanal fishers to boost productivity and sustainability (Boro and Agbugba, 2023).

Governance deficiencies also hinder the sector. Many fishers operate outside formal regulatory frameworks or support structures, increasing the risk of resource overexploitation and heightening conflicts with industrial fishers (Júnior *et al*., 2016). Strengthening governance and involving communities in fisheries management are essential for sustainable outcomes (Kinyua *et al*., 2022). Traditional knowledge and practices can enhance resilience and complement modern strategies to mitigate risks associated with climate and market fluctuations (Anyanwu *et al*., 2022; Nwabeze and Erie, 2013).

Beyond economic value, artisanal fisheries hold cultural significance. They are a source of income and a medium through which communities preserve traditional practices and identity (Derdabi and Aksissou, 2021). However, issues such as gender disparities and limited fisher organisations affect competitiveness in the market (Adetoyinbo and Otter, 2020). Addressing these barriers through training and support programs can empower fishers and improve their economic outcomes (Sogbesan and Kwaji, 2018).

Description of artisanal fishing practices

Artisanal fishing in Nigeria involves a wide variety of tools and techniques tailored to specific environments. Common methods include gill nets, cast nets, and seine nets. Gill nets trap fish by entangling them, while cast nets are hand-thrown and effective in shallow waters. Seine nets are dragged to encircle fish, used in rivers and coastal zones (Ibrahim *et al*., 2010). These nets are often constructed from local materials, with designs adapted to the species being targeted.

Hook and line fishing is another traditional technique, utilised in both freshwater and marine areas. It is simple, selective, and minimises bycatch (Ibrahim *et al*., 2010; Sogbesan and Kwaji, 2018). Some artisanal fishers also engage in aquaculture, cultivating fish in ponds and lakes. Although fish farming is expanding, the majority of production still comes from capture fisheries, with artisanal sources accounting for over 82% of Nigeria's total domestic output (Tyohemba, 2023; Akintola *et al*., 2025a).

Preservation is crucial due to the perishability of fish. Smoking remains the most common method, offering affordability, improved flavour, and extended shelf life (Ogundana, 2023). Other techniques include drying, salting, and refrigeration, although these are less widespread due to cost and infrastructure constraints (Abeni *et al*., 2015). Effective preservation methods reduce post-harvest losses and add value to fish products, improving marketability (Adeyeye *et al*., 2015).

Economic significance of artisanal fisheries

Artisanal fisheries contribute approximately 81.9% of Nigeria's domestic fish supply, amounting to about 1.2 million metric tonnes annually (Omitoyin and Tosan, 2012; Roland, 2019). This underlines their importance in meeting the protein requirements of the population (Adewale, 2024). Despite high production, Nigeria remains the largest fish importer in Africa, signaling a persistent gap between local supply and national demand (Falola *et al*., 2022; Akintola *et al*., 2025b).

The sector provides direct employment to about one million fishers and indirectly supports an estimated 5.8 million people in related industries such as processing, marketing, and distribution (Roland, 2019; Boro and Agbugba, 2023). These activities are particularly crucial in rural, riverine, and coastal communities where alternative income sources are limited (Sogbesan and Kwaji, 2018). Furthermore, artisanal fisheries stimulate local economies by fueling trade and supporting market systems (Olaoye and Ojebiyi, 2018).

In terms of macroeconomic impact, the fisheries sector contributes around 4% to 5.4% of Nigeria's GDP (Omitoyin and Tosan, 2012; Adewale, 2024; Sogbesan and Kwaji, 2018). Income from artisanal fishing not only sustains fisher households but also strengthens food availability and nutrition at the community level (Falola *et al*., 2022). Beyond economic dimensions, artisanal fisheries are embedded in the cultural and social identity of Nigerian coastal communities, serving as a vehicle for heritage preservation (Sogbesan and Kwaji, 2018).

Challenges faced by artisanal fishers

Artisanal fishers in Nigeria contend with numerous challenges. Chief among these is overfishing, driven by

rising demand and the use of unsustainable practices. Traditional methods, while effective, often lack the precision and regulation needed to prevent overexploitation of species (Sumaila and Tai, 2020; Sogbesan and Kwaji, 2018; Akintola *et al*., 2025a). Many fishers operate without licenses or fail to comply with established guidelines, further aggravating stock depletion and endangering food security (Falola *et al*., 2022).

Pollution presents another serious threat. Industrial activities such as oil spills and chemical discharge degrade aquatic habitats (Omonibeke *et al*., 2024; Nkodo *et al*., 2023; Al Mamun Hridoy *et al.*, 2025a,b). Additionally, artisanal refining operations introduce heavy metals and toxins into water bodies, harming fish populations and exposing consumers to health risks (Omonibeke *et al*., 2024; Ikezam *et al*., 2021). Research shows that contaminants like lead and mercury accumulate in aquatic environments, leading to population declines and reduced catch quality (Uzomah *et al*., 2021; Omonibeke *et al*., 2024; Hriody *et al*., 2025b,c). This not only diminishes biodiversity but also undermines the livelihoods and safety of fishing communities (Nkodo *et al*., 2023).

Industrial fishing also intensifies pressure on artisanal fishers. Large commercial vessels, equipped with advanced gear, extract resources at unsustainable rates, often encroaching on traditional fishing grounds (Song *et al.,* 2020; Akintola *et al*., 2025b). This creates conflicts over access and depletes shared fish stocks. Moreover, industrial fleets enjoy greater market access and economic leverage, making it difficult for artisanal fishers to compete (Falola *et al*., 2022; Song *et al*., 2020). Reliance on imported fish exacerbates the problem by lowering demand for local catches and reducing artisanal profitability (Nkodo *et al*., 2023).

SUSTAINABILITY PRACTICES IN ARTISANAL FISHERIES

A study by Sogbesan and Kwaji (2018) revealed low adherence to sustainable fisheries practices among Nigerian artisanal fishers, jeopardizing inland fisheries sustainability. This non-compliance is often tied to limited training and awareness of sustainable methods. John and Adisa (2022) underscored the need to understand fisherfolk's perceptions, suggesting that improved knowledge may foster better adherence to sustainability. Additionally, socio-economic characteristics like education level and resource access significantly shape fishing behaviours and compliance with sustainable practices (Anyanwu *et al*., 2022; Akintola *et al*., 2025a).

Despite producing about 800,000 metric tonnes of fish annually, Nigeria faces a deficit of 1.3 million metric tonnes to meet its estimated demand of 2.1 million (Osuji, 2024; Issa *et al*., 2022). This shortfall highlights the urgency for sustainable management to boost production while conserving aquatic ecosystems. Effective strategies, including ecosystem-based approaches and Marine Protected Areas (MPAs), are recognised as critical for advancing sustainability (Agbeja, 2017; Akintola *et al*., 2025b). Artisanal fishers often hold vital knowledge of local ecosystems and practices that can support conservation efforts (Zahra and Masruroh, 2021).

Definition and principles of sustainable fishing

Sustainable fishing practices aim to reduce environmental impact, recover overexploited stocks, and preserve aquatic ecosystems vital for dependent communities (Asche *et al*., 2018). A core principle is harvesting fish at levels that allow reproduction and sustainability, often measured through Maximum Sustainable Yield (MSY), balancing population growth and catch rates (Irvine *et al*., 2018).

These practices also emphasise ecosystem-based management, recognising the interdependence of species and habitats. Maintaining trophic diversity and ecological balance is key to ensuring fish population resilience (Ouattara *et al*., 2024).

Socio-economic factors are also integral. Effective management must address community needs while preserving ecosystems (Imbwae *et al*., 2023). This includes involving local fishers in decision-making and supporting practices that enhance economic resilience without harming the environment (Nwabeze and Erie, 2013; Akintola *et al*., 2025a).

Beyond ecology, sustainable fishing is critical for global food security. Fish is a primary protein source for billions, and unsustainable fishing threatens its availability (Bernhardt and O'Connor, 2021). Moreover, sustainable fisheries support the economic well-being of both coastal and inland communities (Sogbesan and Kwaji, 2018).

Overview of sustainable practices currently employed

Selective fishing: This practice minimises bycatch by targeting specific fish sizes or species. In Nigeria, overfishing and juvenile catches have caused species declines. Implementing size limits and selective gear, like nets with larger mesh sizes, improves fish stocks and ecosystem health (Nwabeze and Erie, 2013; Eriegha, 2024).

Seasonal closures: Temporarily restricting fishing during spawning periods protects vulnerable populations. In Nigeria, such closures remain underutilised. Research showed these measures can increase fish abundance and size, benefiting fishers over time (Nwabeze and Erie, 2013; Boro and Agbugba, 2023). However, success depends on enforcement and fisher compliance (Ogbeibu, 2023).

Habitat conservation: The degradation of critical habitats

like wetlands and mangroves due to pollution and overfishing threatens biodiversity and fishery resources (Hurtado, 2024). Protecting these ecosystems supports nursery grounds and species diversity (Omitoyin and Tosan, 2012). Community-based conservation has shown promise in restoring fish stocks and strengthening local stewardship (Obot, 2020; Sadauki, 2023).

Community engagement and education: Engaging fishers in management and educating them on sustainability fosters ownership and compliance (John and Adisa, 2022; Nwabeze and Erie, 2013). Participatory approaches empower communities to align fishing practices with environmental and economic needs (Kinyua *et al*., 2022).

Case studies of successful sustainable practices in Nigeria

Community-based fisheries management in Jebba Lake Basin: This initiative involved fishers in regulatory decisions, promoting sustainable techniques such as selective fishing and seasonal closures. The project led to increased compliance and improved fish stocks, demonstrating the value of local participation in resource governance (Nwabeze and Erie, 2013).

Selective fishing in the Niger Delta: In this region, adoption of selective gear and size limits has improved target species populations and economic conditions. Fishers reported more stable and abundant catches, evidencing ecological and livelihood benefits (Ogunji, 2023).

Aquaculture development: Nigeria has become Africa's second-largest aquaculture producer. Environmentally friendly techniques like integrated multi-trophic aquaculture (IMTA) have boosted production while reducing pressure on wild fish stocks. These practices support sustainability and offer economic opportunities (Ogunji, 2023).

BARRIERS TO SUSTAINABLE FISHING PRACTICES IN NIGERIA

Regulatory Challenges: Many artisanal fishers do not comply with sustainable fishing practices, which threatens the sustainability of inland fisheries resources (Sogbesan and Kwaji, 2018). The ineffectiveness of regulatory frameworks has led to widespread overfishing, resulting in a decline in fish stocks and changes in species composition (Olopade *et al.*, 2017). In addition, the failure to observe closed seasons and the use of destructive fishing methods exacerbate the situation, leading to unsustainable exploitation of fish resources (Eriegha, 2024). This regulatory failure is compounded by weak enforcement mechanisms, which allow unsustainable practices to persist unchecked (Olopade *et al.,* 2017).

Environmental challenges: Changes in climate patterns affect fish populations and their habitats, leading to decreased catches and increased competition for dwindling resources (Aderinola *et al.*, 2021). Additionally, anthropogenic activities, such as pollution and habitat destruction, further threaten the ecological balance necessary for sustainable fisheries (Adewale, 2024). The combined pressures from both artisanal and industrial fishing activities intensify these environmental challenges, leading to conflicts over resource use and sustainability (Marengo *et al*., 2015).

Socio-economic challenges: Many fishers operate under conditions of poverty, which limits their ability to invest in sustainable technologies or practices (Awujola, 2023). The reliance on artisanal fisheries as a primary source of livelihood means that economic pressures often drive fishers to prioritise short-term gains over long-term sustainability (Belhabib *et al*., 2017). Additionally, the lack of access to training and resources to adopt sustainable practices further perpetuates this cycle of unsustainability (Nwabeze and Erie, 2013; Akintola *et al*., 2025a). The perception of fishers regarding the importance of sustainable practices is often influenced by their immediate economic needs, which can lead to resistance against regulatory measures aimed at promoting sustainability (John and Adisa, 2022).

Governance challenges: Effective governance is crucial for the sustainability of fisheries, yet many artisanal fishers in Nigeria perceive governance structures as inadequate or ineffective (Kinyua *et al.,* 2022; Akintola *et al*., 2025b). The lack of engagement between fishers and management authorities hampers the development of policies that are both practical and beneficial to local communities (Kiruba-Sankar *et al*., 2021). Moreover, the marginalisation of artisanal fisheries in broader economic and environmental policies further complicates efforts to promote sustainable practices (Ali, 2023). The need for inclusive governance that considers the voices of local fishers is essential for the successful implementation of sustainable fisheries management strategies (Kinyua *et al*., 2022; Kiruba-Sankar *et al*., 2021).

Socioeconomic factors influencing fishing practices

Poverty as a barrier to sustainable practices: Many fishers operate under conditions of extreme financial constraint, which compels them to prioritise immediate economic returns over long-term sustainability (Sogbesan and Kwaji, 2018). The reliance on artisanal fisheries as a primary source of income often leads to overfishing and

the use of destructive fishing methods, as fishers seek to maximise short-term gains to meet their basic needs (Nwabeze and Erie, 2013). Furthermore, poverty restricts access to alternative livelihood opportunities, perpetuating a cycle of dependency on unsustainable fishing practices (Ashley-Dejo and Adelaja, 2022). The economic pressures associated with poverty can lead to a disregard for regulations aimed at promoting sustainability, as compliance may be viewed as an unaffordable luxury (Sogbesan and Kwaji, 2018).

Lack of education and awareness: Many fishers have limited knowledge of the ecological principles that underpin sustainable fisheries management, which hinders their ability to implement effective conservation measures (John and Adisa, 2022; Akintola *et al*., 2025a). Educational deficits can result in a lack of awareness regarding the long-term benefits of sustainable practices, such as the importance of maintaining fish stocks and protecting aquatic ecosystems (Andries *et al*., 2022). Studies have shown that enhancing education and training for fishers can lead to improved fishing practices and greater adherence to sustainability principles (Nwabeze and Erie, 2013). However, the existing educational infrastructure in many rural areas of Nigeria is inadequate, further exacerbating the challenges faced by fishers (Andries *et al*., 2022).

Economic pressures and market dynamics: The need to remain competitive in a market that often favours larger, industrial operations can drive fishers to engage in overfishing and other unsustainable practices (Frawley *et al*., 2019). Additionally, the demand for fish in local and international markets can create incentives for fishers to prioritise quantity over quality, leading to practices that deplete fish stocks (Johnson *et al*., 2020). The economic landscape is often characterised by a lack of access to financial resources, which limits fishers' ability to invest in sustainable practices or diversify their income sources (Ashley-Dejo and Adelaja, 2022). Consequently, economic pressures can lead to a short-term focus that undermines the long-term sustainability of fisheries (Sogbesan and Kwaji, 2018).

Cultural perceptions and attitudes towards sustainability

Traditional beliefs significantly shape fishing practices in Nigerian communities, often promoting ecological balance through seasonal restrictions aligned with fish breeding cycles. These practices, rooted in respect for nature, can support sustainability (Temple *et al*., 2017). However, economic pressures and modern incentives increasingly lead fishers to adopt unsustainable methods. Cultural attitudes toward sustainability are informed by deep indigenous knowledge of ecosystems, fish behaviour, and breeding patterns. Yet, the shift to modern fishing and market influences is eroding this knowledge (Coy *et al*., 2014). The challenge is integrating traditional wisdom into contemporary fisheries management. Economic hardships also cause fishers to prioritise immediate gains over long-term sustainability, and the perceived superiority of modern techniques can devalue traditional methods (Schiller and Bailey, 2021). Still, awareness is growing among fishers about the risks of overfishing and environmental degradation, encouraging some to revive traditional, sustainable practices in response to present-day challenges (Rumagia *et al*., 2020).

IMPACT OF CLIMATE CHANGE ON ARTISANAL FISHERIES IN NIGERIA

Inland fisheries, often involving women, are more vulnerable than predominantly male-dominated marine fisheries, which receive greater policy attention in West Africa (Okeke-Ogbuafor *et al*., 2022). This neglect leaves inland communities with limited support and resilience. Climate change further exacerbates these vulnerabilities by altering species distributions, disrupting habitats, and reducing productivity, threatening food security and livelihoods (Omitoyin and Tosan, 2012; Mustapha, 2013). Changes in breeding and recruitment patterns, species invasions, and vector-borne diseases compound these risks (Mustapha, 2013; Muringai *et al*., 2022).

Adaptive management strategies that account for shifting species dynamics are critical (Free *et al*., 2019; Gaines *et al*., 2018), yet Nigeria lacks the scientific and monitoring capacity to implement them effectively. Integrating ecosystem-based approaches into fisheries management enhances resilience and promotes long-term sustainability (Fogarty *et al*., 2021; Holsman *et al*., 2020). Socio-economic adaptations, including livelihood diversification, gear modification, and selective species targeting, are employed to cope with resource fluctuations (Muringai *et al*., 2022; Lancker *et al*., 2019). However, low adherence to sustainable practices limits progress, highlighting the need for policy reforms that prioritise climate adaptation and actively involve local communities in governance (Sogbesan and Kwaji, 2018; Cisneros-Mata *et al*., 2019).

Overview of climate change effects on fisheries

Climate change significantly alters fish habitats in Nigeria, primarily through rising water temperatures and changes in stratification, which affect fish distribution and breeding patterns (Mustapha, 2013; Omitoyin and Tosan, 2012). Warmer waters may benefit some species while threatening less adaptable ones, leading to shifts in community composition. Altered precipitation patterns also impact freshwater systems, reducing water quality and

flow in rivers and lakes, which are critical habitats for many fish species (Mustapha, 2013; Olu *et al*., 2023).

These climatic changes deepen existing stressors like pollution, overfishing, and habitat degradation, resulting in biodiversity loss and declining fish populations. Invasive species, enabled by climate shifts, further threaten native fish through competition and disease (Mustapha, 2013; Olu *et al.,* 2023). This cumulative impact poses serious threats to food security and economic stability, particularly in vulnerable coastal and inland communities.

Adaptive capacity in these communities is often limited by poor access to information, financial support, and sustainable training (Arimi, 2013; Onyeneke *et al.,* 2019; Onada and Solomon, 2016). Enhancing resilience through targeted training, awareness programs, and climate-informed fisheries management is essential. Adaptive frameworks and sustainable practices can help mitigate climate risks and preserve fish populations for long-term socio-economic stability (Gaines *et al*., 2018).

Adaptation strategies employed by artisanal fishers

Artisanal fishers in Nigeria are increasingly adopting diverse adaptation strategies to cope with the impacts of climate change. A key approach is livelihood diversification, with many shifting towards aquaculture, fish processing, and agricultural activities to reduce dependency on fishing alone (Aderinola *et al*., 2021). This strategy enhances financial stability and helps communities better absorb the shocks of fluctuating fish stocks (Aderinola *et al*., 2021; Adelekan and Fregene, 2014).

Access to and use of weather forecasts has also become essential. Fishers now rely on scientific weather data to guide their operations, helping them avoid hazardous conditions and improve catch efficiency (Okeke-Ogbuafor *et al.,* 2022). Integrating this information with traditional knowledge strengthens resilience in the face of unpredictable climate impacts.

Community engagement and formal networks play a crucial role in adaptation. Collaboration among fishers, local authorities, and NGOs facilitates resource sharing, knowledge exchange, and capacity-building for sustainable practices (Adelekan and Fregene, 2014).

Technological innovation is another area of adaptation. Communities are adopting improved fishing gear and eco-friendly techniques that reduce bycatch and habitat damage, supporting both environmental and economic sustainability (Aderinola *et al*., 2021).

To address climate risks such as flooding, many fishers are investing in resilient infrastructure, including sturdier boats and better storage facilities (Omoyinmi *et al*., 2023). These upgrades enhance operational continuity during extreme weather events and contribute to long-term community resilience. Together, these strategies demonstrate a proactive response to climate challenges in Nigeria’s artisanal fisheries sector.

Role of local knowledge in climate resilience

One of the primary benefits of indigenous knowledge is its ability to inform local practices that enhance resilience to climate variability. For instance, traditional fishing practices and seasonal calendars developed by local fishers allow them to anticipate changes in fish behaviour and availability, thereby optimising their catch (Olaniyan and Govender, 2023; Ajani *et al*., 2013). Such knowledge is often based on long-term observations of environmental changes, making it comparable to scientific data in terms of its relevance and applicability (Ajani *et al*., 2013).

Indigenous knowledge systems often encompass a holistic understanding of the interconnections between various environmental factors. This perspective is essential for developing adaptive strategies that consider the broader ecological context, including the impacts of climate change on biodiversity and ecosystem services (Yongabi, 2023; Brugnach *et al.,* 2014). For example, traditional practices such as rotational fishing and the use of specific gear types can help sustain fish populations and protect habitats, contributing to the overall health of aquatic ecosystems (Olaniyan and Govender, 2023; Ajani *et al*., 2013).

The integration of indigenous knowledge into formal climate adaptation frameworks can also foster community engagement and ownership of adaptation strategies. When local communities are involved in the decision-making processes that affect their livelihoods, they are more likely to adopt and sustain these strategies (Tunde and Ajadi, 2019; Brugnach *et al*., 2014).

Furthermore, the recognition of indigenous knowledge in climate adaptation efforts can help bridge the gap between traditional practices and scientific approaches. Collaborative frameworks that combine indigenous knowledge with scientific research can lead to more comprehensive and effective adaptation strategies (Hiwasaki *et al*., 2014; Mutasa, 2015). For instance, integrating local weather forecasting methods with modern meteorological data can improve the accuracy of climate predictions and enhance the preparedness of fishing communities for extreme weather events (Hiwasaki *et al*., 2014; Tunde and Ajadi, 2019).

COMMUNITY ENGAGEMENT AND STAKEHOLDER INVOLVEMENT

Artisanal fisheries in Nigeria are a vital source of income and nutrition, accounting for over 82% of the country's fish production and providing livelihoods for millions of people (Tyohemba, 2023; Aderinola *et al.,* 2021). Despite their importance, these fisheries face numerous challenges, including competition from industrial fishing practices and the impacts of climate change (Teh and Pauly, 2018; Belhabib *et al.,* 2019). Effective stakeholder engagement is essential to address these challenges, as it fosters

collaboration among fishers, government agencies, and other stakeholders, ensuring that management practices are inclusive and equitable (Wilson 2023; Okafor-Yarwood *et al*., 2022). For instance, participatory governance frameworks can help balance the interests of various groups, thereby promoting sustainable fishing practices that protect both the environment and the livelihoods of local communities (Okafor-Yarwood *et al*., 2022).

The integration of local ecological knowledge into fisheries management is another critical aspect of community engagement. Local fishers possess invaluable insights into the ecosystems they depend on, which can inform sustainable practices and enhance resilience against environmental changes (Rasalato *et al*., 2010). By incorporating these perspectives into management strategies, authorities can develop more effective policies that reflect the realities of artisanal fishing communities (Morales and Martin, 2018).

Moreover, the socio-economic dynamics of artisanal fisheries necessitate targeted interventions that address the unique challenges faced by different stakeholder groups, particularly marginalised populations such as women and youth (Bamigboye and Koledoye, 2022; ODİOKO and BECER, 2022). Engaging these groups in decision-making processes can lead to more equitable resource distribution and improved outcomes for community development (Bamigboye and Koledoye, 2022). For example, initiatives aimed at enhancing the capacity of youth in artisanal fishing can significantly contribute to local economies while ensuring the sustainability of fish stocks (Bamigboye and Koledoye, 2022; Awujola, 2023).

Importance of community-based management approaches

Local fishers possess valuable insights regarding fish behaviour, seasonal patterns, and ecosystem changes, which can significantly inform sustainable management practices (Leite and Gasalla, 2013). By integrating this knowledge, management strategies can be tailored to the specific ecological and socio-economic contexts of the communities, leading to more effective conservation outcomes (Purcell and Pomeroy, 2015). This participatory approach not only enhances the relevance of management measures but also fosters a sense of ownership among community members, which is crucial for compliance and long-term sustainability (Cohen and Foale, 2013).

Community-based management can improve the resilience of fisheries by promoting adaptive management practices that respond to changing environmental conditions and socio-economic pressures. For instance, studies have shown that periodically harvested marine reserves, when managed by local communities, can lead to increased fish stocks and improved yields (Cohen and Foale, 2013; Goetze *et al*., 2017). This adaptive capacity is particularly important in the face of climate change, where traditional management practices may no longer suffice (Purcell and Pomeroy, 2015). By involving communities in the management process, there is a greater likelihood of equitable resource distribution and improved livelihoods (Nwabeze and Erie, 2013). For example, community-managed fisheries often prioritise local needs, ensuring that fish resources contribute to food security and economic stability (Simmance *et al.,* 2022). This is particularly relevant in Nigeria, where artisanal fisheries provide livelihoods for millions and are integral to the food systems of coastal communities (Nwosu *et al*., 2010).

Collaborative management fosters trust and communication among stakeholders, which is essential for resolving conflicts and ensuring compliance with management regulations (Elegbede *et al*., 2023). By building local governance capacities, communities can better advocate for their interests and engage with external stakeholders, including government agencies and NGOs, to secure additional support and resources for sustainable fisheries management (Oloruntuyi *et al*., 2023).

Role of local institutions and governance in sustainability

Local fishers possess invaluable insights regarding fish populations, seasonal variations, and ecosystem dynamics, which can significantly inform sustainable management practices (Okafor-Yarwood *et al*., 2022). By recognising and integrating this knowledge into decision-making processes, local governance structures can develop management strategies that are more aligned with the realities of the fishing communities. This participatory approach not only enhances the relevance of management measures but also fosters a sense of ownership among community members, which is crucial for compliance and the long-term sustainability of fisheries (Aguilera *et al.*, 2015).

Effective governance structures can ensure that the benefits derived from fisheries resources are shared fairly among community members, thereby reducing conflicts and promoting social cohesion (Kyvelou and Ierapetritis, 2020). This is particularly relevant in Nigeria, where artisanal fisheries provide livelihoods for millions and are integral to food security in coastal communities (Rocklin *et al.*, 2011). By prioritising the needs of local fishers and ensuring their voices are heard in decision-making processes, local governance can help to mitigate the socio-economic disparities that often arise in resource management contexts (Bennett *et al*., 2019).

Local governance can enhance collaboration among various stakeholders, including government agencies, NGOs, and the private sector. By fostering partnerships and facilitating dialogue, local governance structures can

create synergies that enhance the effectiveness of fisheries management initiatives (Albouy *et al*., 2010). For example, collaborative governance approaches that involve multiple stakeholders can lead to the development of comprehensive management plans that address both ecological and socio-economic objectives (Cinti *et al*., 2014). This collaborative framework not only strengthens the governance of fisheries but also builds trust and communication among stakeholders, which is essential for resolving conflicts and ensuring compliance with management regulations (Frawley *et al.,* 2019).

POLICY RECOMMENDATIONS

Formulating and implementing effective policies that address both ecological and socio-economic aspects is essential for sustainable and socially beneficial exploitation of artisanal fisheries. Nigeria's small-scale fisheries are governed by national and state laws rooted in the 1999 Constitution, most recently revised in 2010 (Akintola *et al*., 2024). The Federal Department of Fisheries (FDF) is tasked with promoting sustainable fish production, resource utilisation, and conservation (FDF, 2015). Traditional management policies also persist, focusing on resource allocation and gear use (Olopade *et al*., 2017).

Community-based institutions have historically served as de facto managers of local fisheries, preserving resources through various traditional methods enforced by fishers, local authorities, or traditional heads (Madakan *et al*., 2015). However, these regulations have largely failed to ensure sustainability due to non-compliance, outdated laws, lack of comprehensive data, and weak enforcement mechanisms (Sogbesan and Kwaji, 2018; Bolarinwa *et al*., 2016; Olopade *et al*., 2017; Das *et al*., 2025). Some guidelines, such as the FAO Voluntary Guidelines for Small-Scale Fisheries, have been endorsed but not fully implemented (Akintola *et al*., 2024). Effective policy execution requires the active engagement of all stakeholders, including government agencies, research institutions, environmental organisations, and fishing communities.

Suggestions for improving regulatory frameworks

The current artisanal fisheries regulations and management techniques need to be improved and better adapted to the needs of the sector in order to guarantee adherence and to promote the sustainability of artisanal fisheries in Nigeria. One of the drawbacks of existing policies is the lack of cohesion between the implementing bodies and the key actors of artisanal fisheries, which are the fisherfolk (Moses-Oke and Erhun, 2022). One of the ways to tackle this is to introduce co-management systems involving both government and local fishing communities in the decision-making process to improve compliance and management. Co-management ensures that regulations are more contextualised and that communities are empowered to manage their resources responsibly.

The existing regulations are also hindered by inadequate enforcement due to limited resources and oversight (Fakoya and Akintola, 2018). To ensure compliance, it is imperative to:

- Strengthen the capacity of local enforcement agencies and fisheries officers.
- Implement advanced surveillance and monitoring systems, such as utilising modern technologies like satellite tracking for real-time observation of fishing activities.
- Foster collaboration with coastal patrols and marine law enforcement to deter illegal, unreported, and unregulated (IUU) fishing.

Recommendations for enhancing community participation

1. Establish inclusive, recognised community-based fisheries committees involving fishers, elders, women, and youth.
2. Promote community-based Monitoring, Control, and Surveillance (MCS) to enhance participation and compliance.
3. Adopt co-management systems that give local communities a key role in decision-making.
4. Empower women through inclusion in committees, and provide training in sustainable practices and business skills.
5. Provide training for fishers on sustainable techniques, fisheries management, and climate change adaptation.
6. Incentivise compliance by supporting sustainable gear and rewarding communities practising effective resource management.

CONCLUSION

Artisanal fisheries play a central role in Nigeria's food supply, employment, and coastal economies. This study shows persistent pressure from overfishing, climate variability, habitat decline, and weak institutional oversight. These pressures reduce stock productivity and threaten household incomes. Sustainable fishing practices and ecosystem-based management offer a clear path to reverse these trends. Effective governance, grounded in science and local realities, stands as a priority for long-term sector stability.

The findings highlight the value of community-based management and the integration of traditional ecological knowledge. Local participation improves rule compliance,

monitoring, and legitimacy. Co-management arrangements, clear access rights, and transparent enforcement strengthen outcomes. Social factors demand equal attention. Poverty, limited education, and restricted access to finance constrain the uptake of sustainable gear and practices. Targeted training, extension services, and practical education raise awareness and skills across fishing communities.

Economic support mechanisms support behaviour change. Access to credit, gear exchange programs, and market incentives for responsibly harvested fish reduce short-term income risks. Diversified livelihoods such as aquaculture, processing, and non-fishing activities lower pressure on wild stocks. Coordinated action among fishers, regulators, researchers, and community leaders underpins success. Such collaboration aligns conservation goals with development needs. Sustained commitment to these measures secures food security, protects aquatic biodiversity, and strengthens economic resilience across Nigeria's artisanal fisheries.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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